

**TRIMACRACANTHUS GEN. NOV. (CESTODA: TRYPANORHYNCHA:
EUTETRARHYNCHIDAE), WITH REDESCRIPTIONS OF *T. AETOBATIDIS*
(ROBINSON, 1959) COMB. NOV. AND *T. BINUNCUS* (LINTON, 1909) COMB. NOV.**

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Summary

BEVERIDGE, I. & CAMPBELL, R. A. (1987) *Trimacracanthus* gen. nov. (Cestoda: Trypanorhyncha: Eutetrarhynchidae), with redescriptions of *T. aetobatidis* (Robinson, 1959) comb. nov. and *T. binuncus* (Linton, 1909) comb. nov. *Trans. R. Soc. S. Aust.* 111(3), 163-171, 30 November, 1987.

Trimacracanthus gen. nov. is erected within the Eutetrarhynchidae Guiart, 1927 for two species, *Prochristianella aetobatis* Robinson, 1959 and *Rhynchobothrium binuncum* Linton, 1909. Both species are redescribed. The new genus is most similar to *Prochristianella* Dollfus, 1946 in possessing a large basal swelling of the tentacle and a distinct basal armature, but differs in having an asymmetrical swelling and a triad of grossly enlarged hooks on the external surface of the swelling. The two species are distinguished from one another by number of hooks in each principal row, size of hooks and number of testes in mature segments.

KEY WORDS: Cestoda, Trypanorhyncha, Eutetrarhynchidae, *Trimacracanthus*, *Prochristianella aetobatis*, *Rhynchobothrium binuncum*.

Introduction

Recent collections of cestodes from South Australian elasmobranchs included the trypanorhynch *Prochristianella aetobatis* Robinson, 1959 which is apparently a prevalent parasite of some of the species of rays occurring in coastal waters. In preparing a redescription of the species a number of significant differences from congeners became apparent. In addition it was noted that another species of trypanorhynch, *Rhynchobothrium binuncum* Linton, 1909, described from a stingray from the northwestern Atlantic and currently considered a species *incertae sedis* (Yamaguti 1959; Schmidt 1986) shared several of the distinctive features found in *P. aetobatis*. In this paper we redescribe both species and show that they constitute a new genus within the Eutetrarhynchidae, related to *Prochristianella*.

Materials and Methods

Specimens of *P. aetobatis* were obtained from the spiral valves of rays from South Australian coastal waters. Cestodes were either washed in sea water, relaxed briefly in tap water, then fixed in 10% buffered formalin, or the spiral valve contents were fixed with hot formalin and the cestodes were subsequently removed in the laboratory. Cestodes were

stained with Celestine blue, dehydrated in ethanol, cleared in clove oil and mounted in balsam. Six specimens were also examined by scanning electron microscopy. Type specimens of *P. aetobatis* were borrowed from the National Museum of New Zealand (NMNZ). All new material collected has been deposited in the Australian Helminth Collection (AHC) of the South Australian Museum, Adelaide. Additional specimens of *P. aetobatis* have been deposited in the British Museum (Natural History), London (BMNH), and the United States National Museum Helminth Collection, Washington (USNMHC). Type specimens of *R. binuncum* were borrowed from USNMHC.

Measurements are presented in the text in micrometres, unless otherwise stated. The range is followed by the mean in parentheses. Unless otherwise indicated, 10 measurements were made of each organ.

Terminology for the various elements of trypanorhynch anatomy follows Dollfus (1942) and Schmidt (1986).

***Trimacracanthus* gen. nov.**

Generic diagnosis: Eutetrarhynchidae Guiart, 1927. Scolex slender, elongate, acraspedote. Pars bulbosa and pars vaginalis much longer than pars bothridialis. Bulbs long and slender. Tentacle sheaths sinuous but not spiral. Prebulbar organs present. Retractor muscle attached at posterior extremity of bulbs. Two bothridia, margins thick, free, not contiguous apically, may be notched posteriorly suggesting incipient subdivision. Tentacles long with asymmetrical basal swelling

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bearing distinctive basal armature. Metabasal armature heteroacanthous, heteromorphous, typical. Hooks solid. Metabasal armature of alternate half spiral rows beginning with large hook 1 (1') with recurved point and long base of implantation. Hooks 2 (2') also large but smaller than 1 (1'); remaining hooks diminish in size becoming slender and shorter as row continues towards external face. Strobila acraspedote, hyperapolytic. Genital pore marginal. Testes medullary, prevarian. External seminal vesicle present. Ovary posterior, 4-lobed in cross section. Seminal receptacle present. Uterus median. Vitellaria circumcortical.

Type species: *T. aetobatidis* (Robinson, 1959) comb. nov.

Other species: *T. hinuncus* (Linton, 1909) comb. nov.

Trimacracanthus aetobatidis (Robinson, 1959)
comb. nov.
FIGS 1-15

Prochristianella aetobatus Robinson, 1959, pp. 390-391, figs 26-34.

Types: Holotype from spiral valve of *Aetobatus narinari* Mueller & Henle, 1841 (syn. *A. tenuicaudatus*), New Zealand (precise locality unknown), March 1955, coll. E. S. Robinson, holotype NMNZ ZQ203, paratypes NMNZ ZW 204-206.

Material Examined: from *Aetobatus narinari*: paratypes NMNZ (ZW 205-6). From *Trygonorkina guenerius* Whitley, 1932 (new host record): 23 specimens, Goolwa, S. Aust. (AHC S2760, USNMHC 79592); 1 specimen, Marion Bay, S. Aust.; 38 specimens, Middleton, S. Aust. (AHC S2358); 1 specimen, Port Stanvac, S. Aust. (AHC S2763); 3 specimens, Cowell, S. Aust. (AHC S2762).

From *Myliobatis australis* Macleay, 1881 (new host record): 8 specimens, Middleton, S. Aust. (AHC S2355); 1 specimen, Young Rocks, Kangaroo Island, S. Aust. (AHC S2764); 11 specimens, Goolwa, S. Aust. (AHC S2756); 1 specimen, Port Lincoln, S. Aust. (AHC S2766).

From *Dasyatis brevicaudatus* (Hutton, 1875) (new host record): 11 specimens, Northaven, S. Aust. (AHC S2768); 1 specimen, Port Vincent, S. Aust. (AHC S2769); 16 specimens, Strenky Bay, S. Aust. (AHC S2767).

From *Dasyatis thetidis* Waite, 1899 (new host record): 4 specimens, Cowell, S. Aust. (AHC S2770).

From *Mustelus antarcticus* (Günther, 1870) (new host record): 1 specimen, Goolwa, S. Aust. (BMNH 1987.4.7.4).

Description: Slender, delicate worms, up to 15 mm long, consisting of up to 15 acraspedote segments. Scolex acraspedote (Fig. 2), 2.54-2.99 (2.77) mm long, 380-530 (410) wide with two, well separated patelliform bothridia 350-470 (400, n=5) in diameter. Bothridial margins free, indented posteriorly, borders thick, terminating as short ridges on internal surface of bothridium (Fig. 7). Pars

bothridialis 360-460 (420); pars vaginalis 1.2-1.4 (1.31) mm; pars bulbosa 1.18-1.50 (1.38) mm. Ratio of pars bulbosa to pars vaginalis 1:0.95. Tentacles up to 2.22 mm long, 40-70 (50) in diameter excluding hooks; prominent asymmetrical basal swelling, 50-110 (80) wide (Figs 12-14). Tentacle sheaths sinuous with some coils, not spiral. Bulbs at least eight times longer than wide, 1180-1500 (1300) by 140-180 (160); origin of retractor muscles at base of bulb, surrounded by irregular clumps of gland cells; prebulbar organs present. Red pigmentation anterior to bulbs in living specimens. Pars postbulbosa very short, 35-110 (67).

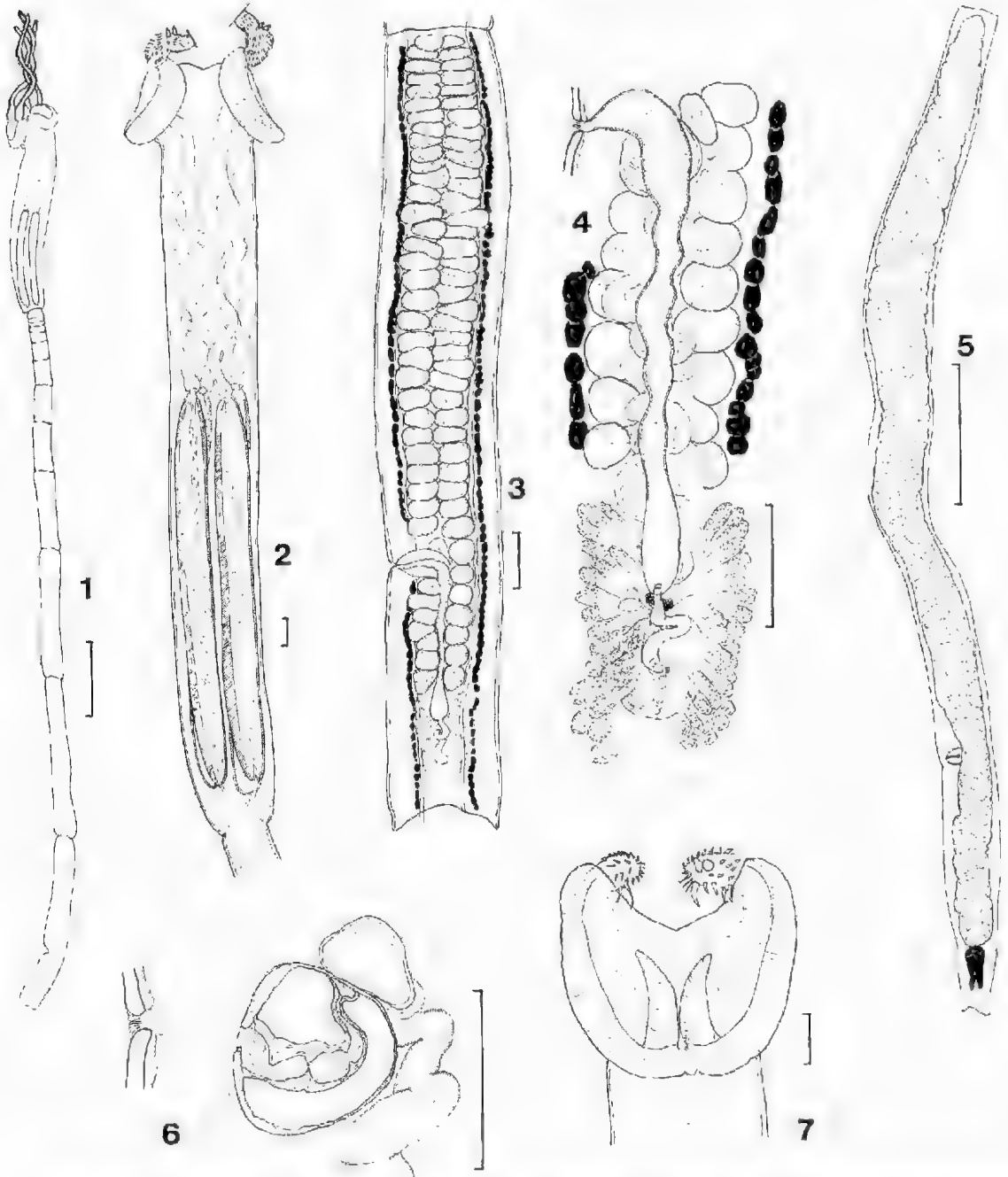
Armature heteroacanthous, heteromorphous typical; hooks solid. Metabasal armature (Figs 9-11) consists of alternating, ascending, half spiral rows of 10-11 hooks at mid-tentacle; 12-14 hooks per half spiral row near tip of tentacle. Rows begin on internal face with hooks 1 (1') well separated, ending on external face where half spiral rows meet to form inverted V. Hooks of principal rows begin with single large hook with long base of implantation, remaining hooks become more slender with shorter bases on bothridial and antibothridial faces; hooks of external face much reduced in size. All hooks become smaller toward tip of tentacle. Hook dimensions in mid-region of tentacle: 1 (1') arcuate, stout, 34-46 (43) long, base length 20-30 (24); hooks 2 (2') straighter (Fig. 10), more slender, tip curved, 38-54 (44) long, base length 16-18 (17); hooks 3 (3') slender, spiniform with short base 38-50 (46), base 10-18 (16); hooks 4 (4') 38-48 (44) long, base 14-24 (17); hooks 5 (5') 32-46 (40) long, base 12-16 (15); hooks 6 (6') 28-40 (32) long, base 10-14 (13); hooks 7 (7'), 18-32 (23) long; 8 (8'), 12-20 (16) long; 9 (9')-11' (11'), 10-20 (15) long.

Basal armature (Figs 12-14) consists of eight rows of hooks on basal swelling of tentacle; hooks dissimilar on external and internal surfaces. Hooks of internal surface organized into alternate, ascending half spiral rows with hooks 1 (1') well separated. Proximal rows one to four consist of series of large spiniform hooks, gradually decreasing in size as rows continue towards external surface. Rows five to eight begin with stout rose-thorn shaped hooks 1 (1'); row five continues as series of spiniform hooks much stouter than those of proximal rows one to four. Half spiral rows one to five terminate in series of four to eight small spiniform hooks on external surface in inverted V-formation. Rows six to eight with reduced numbers of hooks. On external surface, opposite rows six to eight, distinct promontory present, surmounted by triad of large cone-shaped hooks with rounded, festooned bases (Figs 12, 13). Central hook 24-42 (36) long with recurved point, base diameter 18-32 (26). Posterolateral hooks of triad

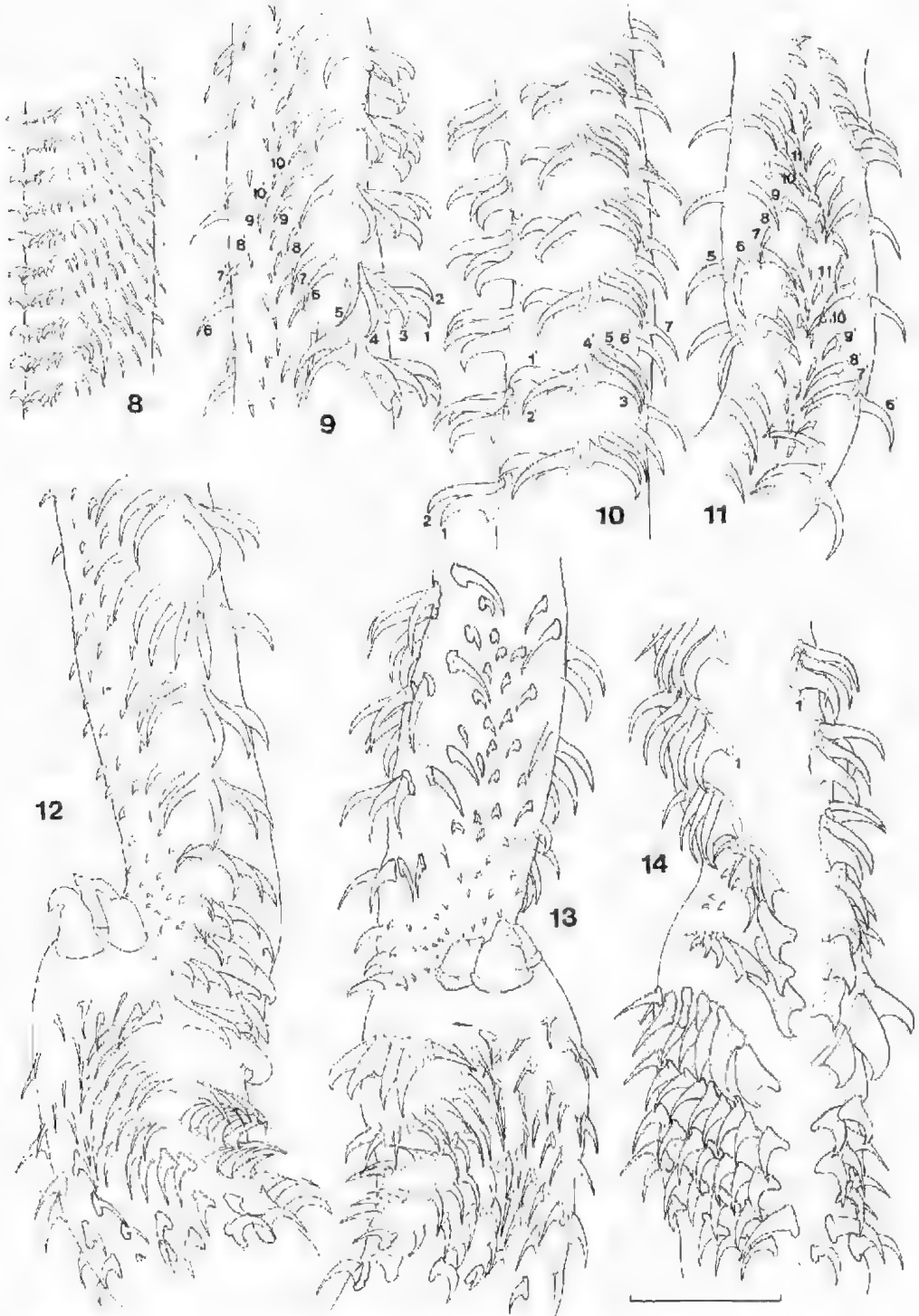
dissimilar, more slender of pair 30-38 (33) long with rebated point; base diameter 18-24 (21); slouter hook 30-36 (33) long, base 16-24 (21).

Mature segments 1.19-3.09 (1.99) mm by 180-310 (260); detached gravid segments 2.30-4.21 (3.11) mm

by 220-400 (300). Genital pores irregularly alternate, in posterior 1/3 of mature segment, 67% of segment length from anterior end; 75% of segment length from anterior end of gravid segments. Genital atrium small. Cirrus sac globosc, 70-140



Figs 1-7. *Trimacracanthus aetobatidis* (Robinson). 1, entire cestode; 2, scolex; 3, mature segment; 4, female genitalia; 5, gravid segment; 6, cirrus sac with external seminal vesicle; 7, bothridia. Scale lines: fig. 1, 5, 1.0 mm; figs 2-4, 6-7, 0.1 mm.



Figs 8-14. *Trimacracanthus uetobatidis* (Robinson), tentacular armature. 8, bothridial surface of tentacle, 0.1 mm from tip of fully extended tentacle; 9, bothridial surface, metabasal region, 0.8 mm from base; 10, antibothridial surface, metabasal region, 0.8 mm from base; 11, external surface, metabasal region, 1.9 mm from base; 12, basal region of tentacle, bothridial surface; 13, basal region, external surface; 14, basal region, internal surface. Scale line: 0.1 mm.

(100) by 30-110 (80); cirrus unarmed. External seminal vesicle pyriform (Fig. 6), adnate to cirrus sac; vas deferens coiled, located in midline between cirrus sac and ovary. Testes preovarian, subspherical, 50-100 by 40-50, forming two parallel rows; testes number 68-85 (76) per segment; testis distribution: postvaginal and poral 6-8 (7); prevaginal and poral 28-35 (31); antiporal row 34-43 (38). Vagina passes anteroventral to cirrus pouch, turns sharply posterior in midventral line and descends to ovary. Vagina divided into two segments; first segment greatly expanded from genital atrium to anterior level of ovary where sperm are stored, wall lined by simple epithelium; constricts forming second segment, narrow sperm duct passes ventral to ovarian isthmus and joins ootype. Ovary bilobed in dorsoventral view, lobes subequal, 130-270 (190) by 30-60 (40); Mehlis' gland 80-220 (150) in diameter. Vitelline follicles circumcortical, 80 in diameter. Uterus saciform in detached gravid segments, filling entire preovarian medullary region.

Trimacracanthus binuncus (Linton, 1909)

comb. nov.

FIGS 16-25

Rhynchobothrium binuncum Linton, 1909, pp. 181-182; figs 55-64.

Types: Lectotype from spiral valve of *Dasyatis say* (Le Sueur, 1886), Tortugas, Florida, USNMHC No. 9010; paralectotypes, USNM 9010.

Material examined: from *Dasyatis say*; 4 types, USNMHC 9010.

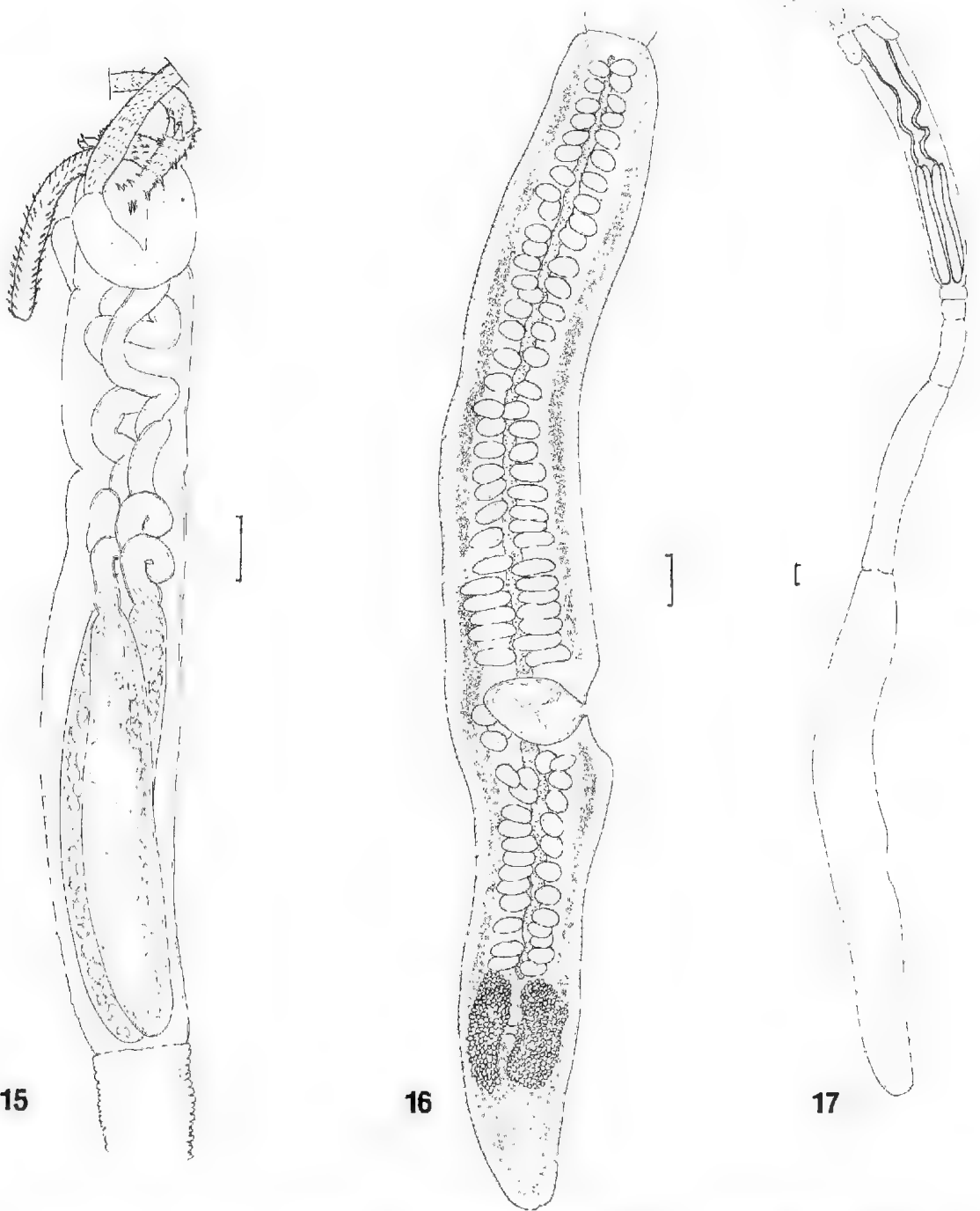
Description: Small, delicate worms, 4.9-6.4 (5.7) mm (n=2) long, consisting of 5-6 (n=4) acraspedote segments, last segment comprising 65% or more of total length of worm (Fig. 16). Scolex acraspedote (Fig. 15), 1.30-1.65 (1.53) mm (n=4) long by 190-280 (248) (n=3) wide, with two rounded, well separated, bothridia, 175-250 (216) (n=4) long by 160-250 (203) (n=3) in diameter. Bothridial margins free, borders thick, no indentation or incipient division on posterior border. Pars bothridialis 175-250 (223) (n=4); pars vaginalis 800-960 (853) (n=4); pars bulbosa 750-830 (787) (n=4). Ratio of pars bulbosa to pars vaginalis 1:1.09. Tentacles extended in SSD but not fully everted. Tentacle widths, excluding hooks, 80 wide at basal swelling in lateral view, lower metabasal diameter 55, mid-tentacle diameter 45, tip diameter 45. Tentacle sheaths sinuous with few coils. Bulbs elongate, 770-830 (778) (n=4) by 70-100 (83) (n=4), retractor muscle originates at base of bulb, surrounded by irregular mass of gland cells; prebulbar organ present. Pars postbulbosa absent.

Armature heteroacanthous, heteromorphous, typical; hooks solid. Metabasal armature (Figs 19,

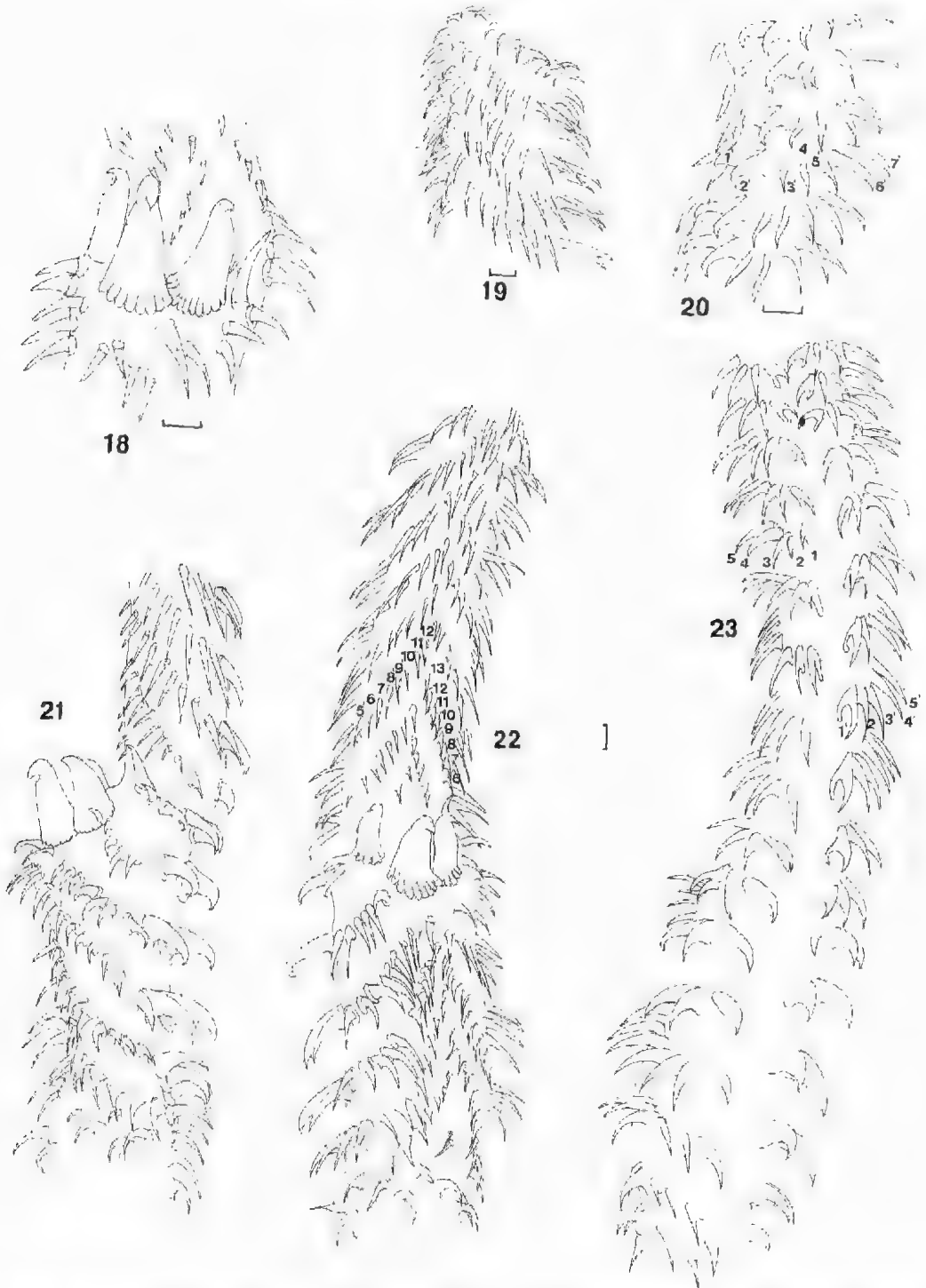
20, 22, 23) consists of alternating, ascending, half spiral rows of 12-14 hooks each. Rows begin on internal surface with hooks 1 (1') well separated, ending on external surface in inverted V-formations. Hooks 1 (1') large, falciform, with extended posterior heel; remaining hooks of principal rows straighter, falciform then spiniform, gradually decreasing in size. Hook dimensions in mid-region of tentacle: 1 (1') stout, strongly recurved, with extended heel, 16-32 long, base length 15-20, heel 4-5 long, height 9-23; hooks 2 (2') similar to 1 (1') except straighter and with reduced base, length 19-20, base length 11-12, height 10-11; hooks 3 (3') spiniform, length 15-18, base length 6-8, height 10-11; hooks 4 (4')-9 (9') decreasing in length from 25-20; hooks 10 (10')-14 (14') only 17-18 long.

Basal armature (Figs 21-23) consists of six rows of hooks on basal swelling of tentacle; hooks dissimilar on external and internal faces. Hooks of internal face organised into alternate ascending half spiral rows with hooks 1 (1') widely separated. Rows begin with stout falciform hooks with long posterior heel, oriented transversely; remaining hooks of proximal rows spiniform, gradually decreasing in size as rows continue toward external surface. Smaller spiniform hooks on external face meet in inverted V formations (Fig. 22). Distinct promontory on external face surmounted by triad of large cone-shaped hooks with rounded, festooned bases and recurved points (Fig. 18). Foremost hook of triad largest, length 34-42, base diameter 18-25. Posterolateral hooks of triad unequal; hook adjacent bothridial side larger, length 28-38, base diameter 16-28; hook adjacent to antibothridial face smallest of triad, length 24-28, base diameter 8-12.

Mature segments 1.07-1.27 (1.17 mm) (n=3) long by 150-210 (187) (n=3) wide; terminal segments, 3.12-4.45 (3.67 mm) (n=4) long by 200-400 (300) (n=4) wide, nongravid. Genital pores irregularly alternate, in posterior half of mature segment. Detached gravid segments not present. Cirrus sac pyriform, 60-90 (69) (n=4) by 23-34 (29) (n=4), external seminal vesicle 40-50 (n=2) in diameter, adnate to cirrus sac. Vas deferens coiled, forming loop, extending in medial line posteriorly to level of ovaries. Testes preovarian, ovoid, dimensions 60-70 wide by 20 long, forming two parallel rows. Testes number 105-109 (107) (n=2) per segment; testis distribution, postvaginal, poral 13-15 (n=2); prevaginal, poral 35-39 (n=2), antiporal 54-56 (n=2). Ovary bilobed in dorso-ventral view; lobes subequal, 240-260 (n=2) by 160-220 (n=2). Vagina forms seminal receptacle 80 in diameter, Mehlis' gland well developed, postovarian. Vitelline follicles circumcortical, continuous from anterior to posterior margins of segment.



Figs 15-17. *Trimacracanthus binuncus* (Linton). 15, scolex; 16, terminal segment; 17, entire worm. Scale lines: fig. 17, 1.0 mm; figs 15-16, 0.1mm.



Figs 18-23: *Trimacracanthus binuncius* (Linton). 18, triad of enlarged hooks on external surface of basal swelling; 19, metabasal region, antibothridial surface; 20, metabasal region, internal surface to left; 21, basal armature, bothridial surface; 22, basal and metabasal armature, external surface; 23, basal and metabasal armature, internal surface; note long guards on hooks 1 (1') of metabasal region. Scale line: 0.1 mm.

Discussion

The two species described above possess a combination of characters not found together in other eutetrarhynchid cestodes, in particular, an asymmetrical basal swelling armed with a triad of large hooks and a metabasal armature composed of ascending half-spiral rows of hooks with hooks which diminish in size from the internal to the external surface suggesting that a new genus is needed to accommodate them.

Dollfus (1942) assigned two genera to the Eutetrarhynchidae, namely *Eutetrarhynchus* Pintner, 1913, and *Christianella* Guiart, 1933. He later (1946) added *Diesingella* Guiart, 1931, and *Tetrarhynchobothrium* Diesing, 1850 and created two new genera, *Prochristianella* Dollfus, 1946 and *Parachristianella* Dollfus, 1946 bringing the total number of eutetrarhynchid genera to six. Dollfus (1969) subsequently removed *Tetrarhynchobothrium* from the Eutetrarhynchidae and made it the type genus of a new family, Tetrarhynchobothriidae Dollfus, 1969 which remains monotypic; *Mecistobothrium* Heinz & Dailey, 1974 is a more recent addition to the family Eutetrarhynchidae. Unfortunately *Diesingella* and *Christianella* remain very poorly defined and require a thorough redescription to be properly included in current systematics. *Mecistobothrium* appears, from its description (Heinz & Dailey, 1974), to be very similar to *Renibulbus* Feigenbaum, 1975, originally placed in its own family, Renibulbidae (Feigenbaum, 1975). Subsequently, *Renibulbus* was placed as a synonym of *Eutetrarhynchus* along with *Tetrarhynchobothrium* by Schmidt (1986). Schmidt (1986) also added *Oncomegas* Dollfus, 1929 to the family.

Limits of the genera, *Eutetrarhynchus*, *Prochristianella* and *Parachristianella* are not clear and this has resulted in confusion in the allocation of species to genera. In defining the genus *Prochristianella*, Dollfus (1946) emphasized two principal characters; the increase and subsequent decrease in metabasal hook size from internal to external surfaces in *Prochristianella* compared with a decline in hook size in *Parachristianella*; and the presence of a tentacular basal swelling with a characteristic armature in *Prochristianella* but not in *Parachristianella*. He placed two species in *Prochristianella*, the type species, *P. trygonicola* with a heteromorphic metabasal armature and *P. tenuispine* (Linton, 1890) with a homomorphic armature. Dollfus (1946) defined *Parachristianella* as having a decrease in hook size from internal to external surface and lacking a basal swelling of the tentacle. Subsequently, Kruse (1959) added two new species to the genus which conformed closely with Dollfus' definition. Yamaguti (1959), however, ignored the

nature of the metabasal armature in his key to genera of the family relying instead on the presence of a basal swelling and it is evident from the literature that some workers have followed Yamaguti's key rather than Dollfus' original diagnosis. Of specific concern here is Robinson's (1959) description of *Prochristianella aetobatis* from New Zealand which combines the metabasal armature of *Parachristianella* with the basal armature on a tentacular basal swelling like *Prochristianella*. Following the key of Yamaguti (1959), Robinson (1959) placed the species in *Prochristianella* but with some hesitation, as museum records show he had originally considered using a new generic name for the species, *Trimacracanthus*. We consider that the two species described above fit neither *Prochristianella* nor *Parachristianella*, and that a new genus is required to accommodate them, for which we propose to use the name initially suggested by Robinson in notes attached to the type specimens.

Distinctive characters of the new genus *Trimacracanthus* are the combination of a metabasal armature similar to *Parachristianella* but with a prominent, asymmetrical tentacular basal swelling bearing a distinctive armature including the presence of a triad of enlarged hooks. The two species placed in the new genus are *T. aetobatidis* and *T. binuncus*. *T. binuncus* was originally described by Linton (1909) and regarded by Yamaguti (1959) and Schmidt (1986) as *incertae sedis*. The syntypes of *Rhynchobothrium binuncum* (USNM 9010) were examined and the ontogeny and anatomical features were found to be very similar to but distinct from those of *T. aetobatidis*. Both species possess a metabasal armature of the typical heteracanthous type in which the hook sizes begin with very large hooks then decrease in size towards the external surface. Also, both species have a pronounced asymmetrical basal swelling with a distinct basal armature. There are three cone-shaped hooks on the external face of the basal armature in both species. *T. aetobatidis* may be distinguished from *T. binuncus* by the following features: number of hooks per principal row at mid-tentacle (10-11 versus 12-14); hooks 1 (1') in the principal rows lack an extended posterior heel in *T. aetobatidis* but a heel is pronounced in *T. binuncus*; a sharp transition in hook size on the external face (*T. aetobatidis*) versus a gradual decrease in hook size (*T. binuncus*); testis number per segment (68-85 in *T. aetobatis* versus 105-109 in *T. binuncus*); number of segments (15 versus 6); nonspinous scolex and strobila of *T. aetobatidis* versus a spinous condition in *T. binuncus*, and presence of a short pars postbulbosa in *T. aetobatidis* which *T. binuncus* lacks.

Robinson (1959) used two names, *P. aetobatis* and *P. aetobatidis*, in his description of the species. As the host genus is *Aetobatus*, we assume that *P. aetobatis* is a typographical error, and have adopted the name *aetobatidis*.

Southwell (1929) reported a single specimen of *R. binuncum* (as *Tentacularia binunca*) from *Dasybatus? walga* from the "Ceylon Pearl Banks", and reproduced Linton's (1909) figures of the species. The whereabouts of Southwell's specimen is not known, and hence its identity cannot be ascertained.

Acknowledgments

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